Welding camera as a tool for interactive and iterative learning:

Towards analytical and evolving welding skills

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Full Presentation video:

ArcLess Academy at SCHWEISSEN & SCHNEIDEN Future Hub : How Welding Cameras Transform Weld Education

https://www.youtube.com/watch?v=5yQ76TX1tKI&t=34s

EDUCATION – NEW TECHNOLOGIES

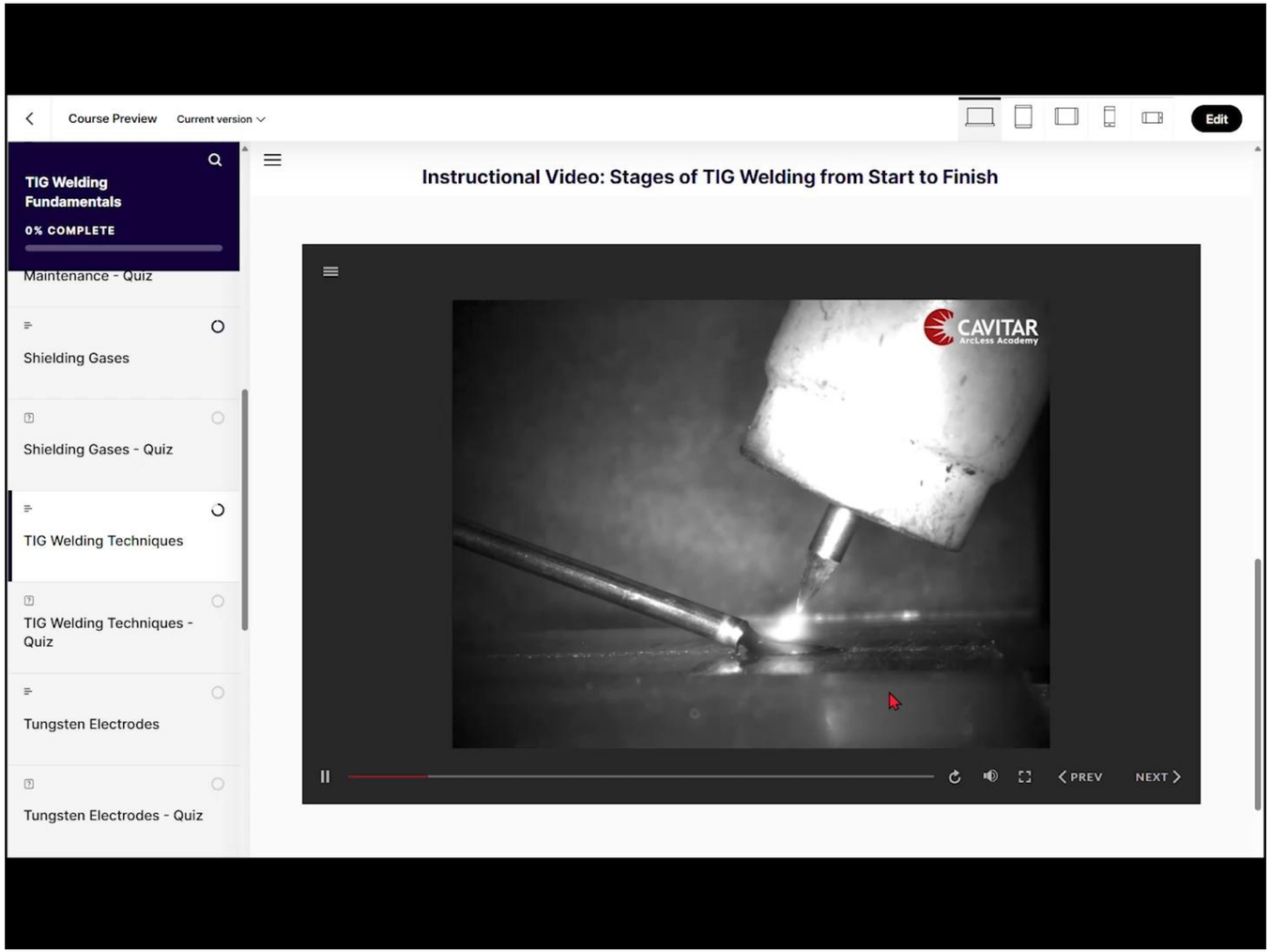
A. Flipped learning

B. High technology and learning material

C. Online platform

D. Welding cameras as a teaching tool

E. Future option



A FLIPPED LEARNING

CAVITAR
VALUE IN SIGHT

Iterative learning using PDCA-Model study cycle

1 Plan
Flipped learning (LMS)

Strengths and area for improvement are identified, and understanding is further deepened.

2 Do
Practical welding training

Recording the weld with welding camera.

3 Check
Learning from

video analysis and welding inspection from the weld piece.

4 Adjust
Learning

Strengths and area for improvement are identified, and understanding is further deepened.

Do again
Improving performance

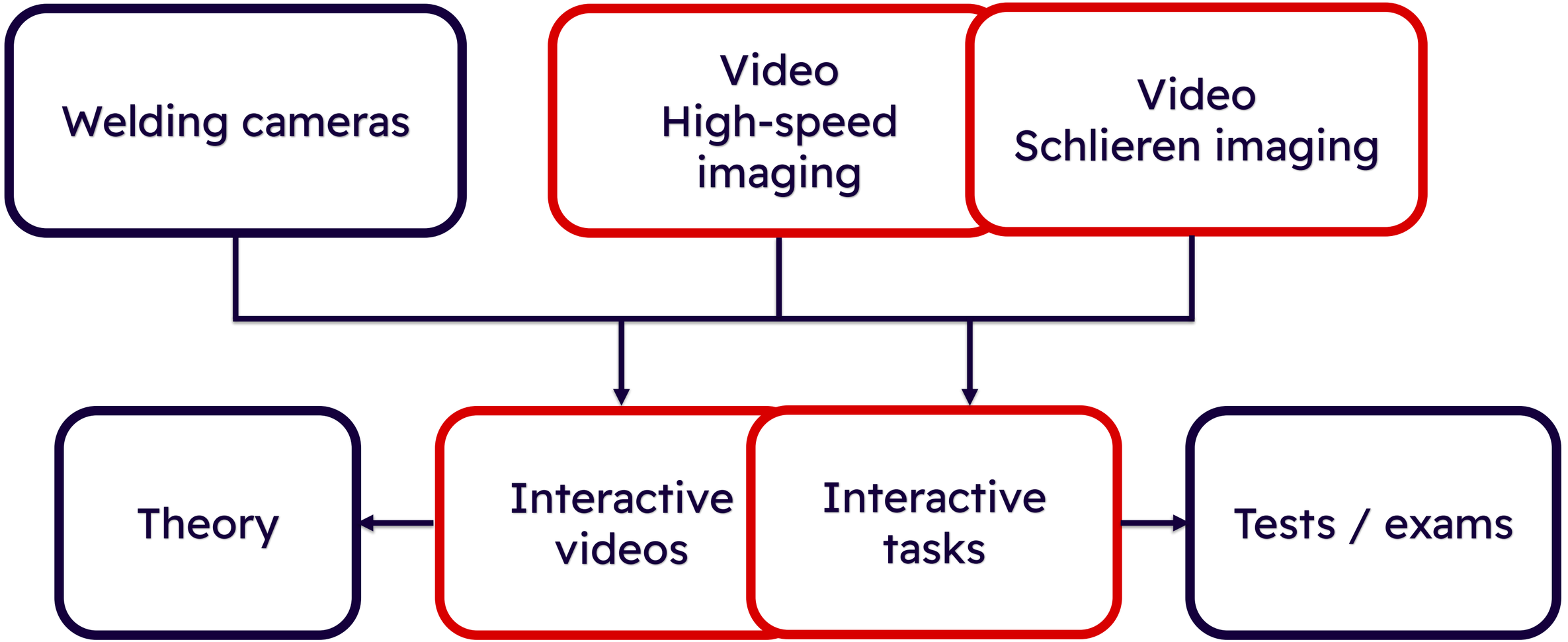
Back to cycle **2.**
(or 1, if there are deficiencies in theoretical knowledge)

The welder practices again, makes corrections and step by step refines

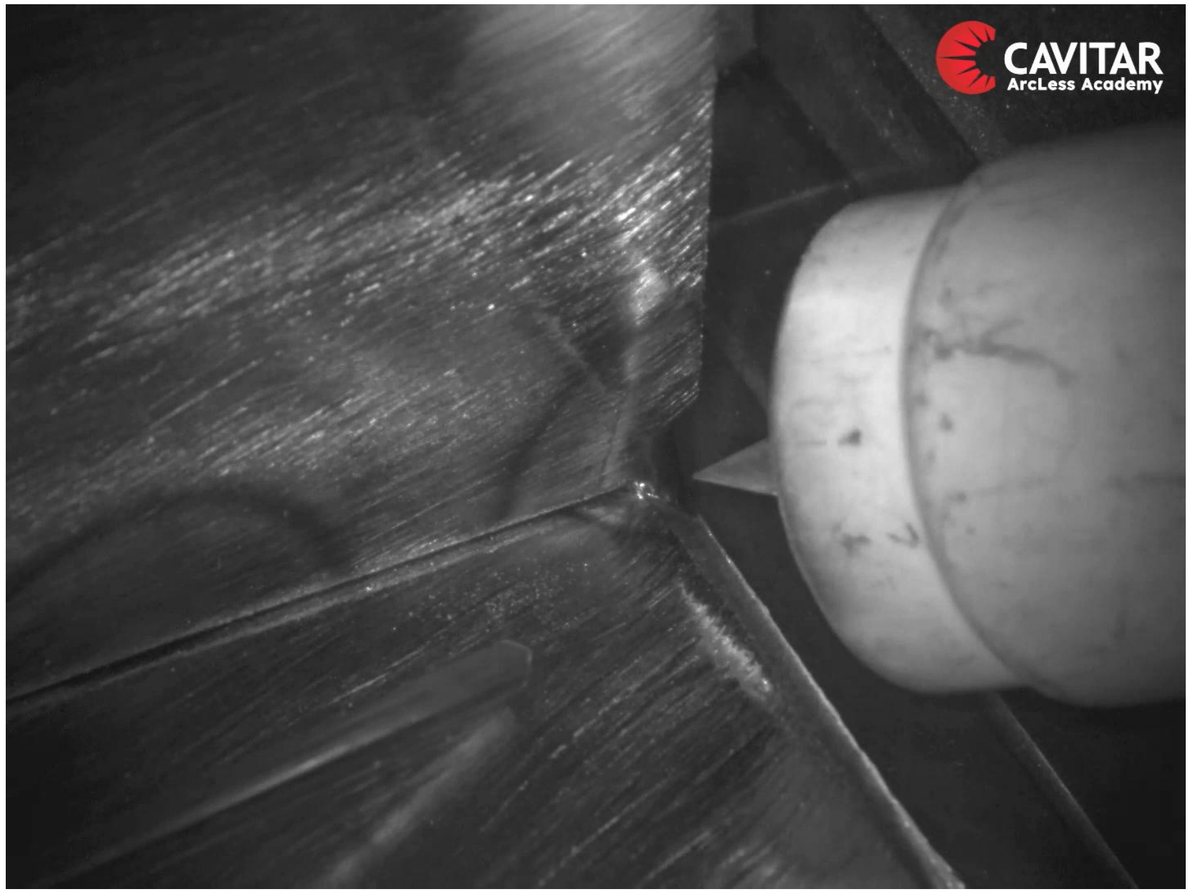
A. FLIPPED LEARNING

- Theory first → self-study with interactive videos and theory materials
- Theory class time → practice, feedback & problem-solving
- More interaction & deeper learning with theory material

B. HIGH TECHNOLOGY AND LEARNING MATERIAL



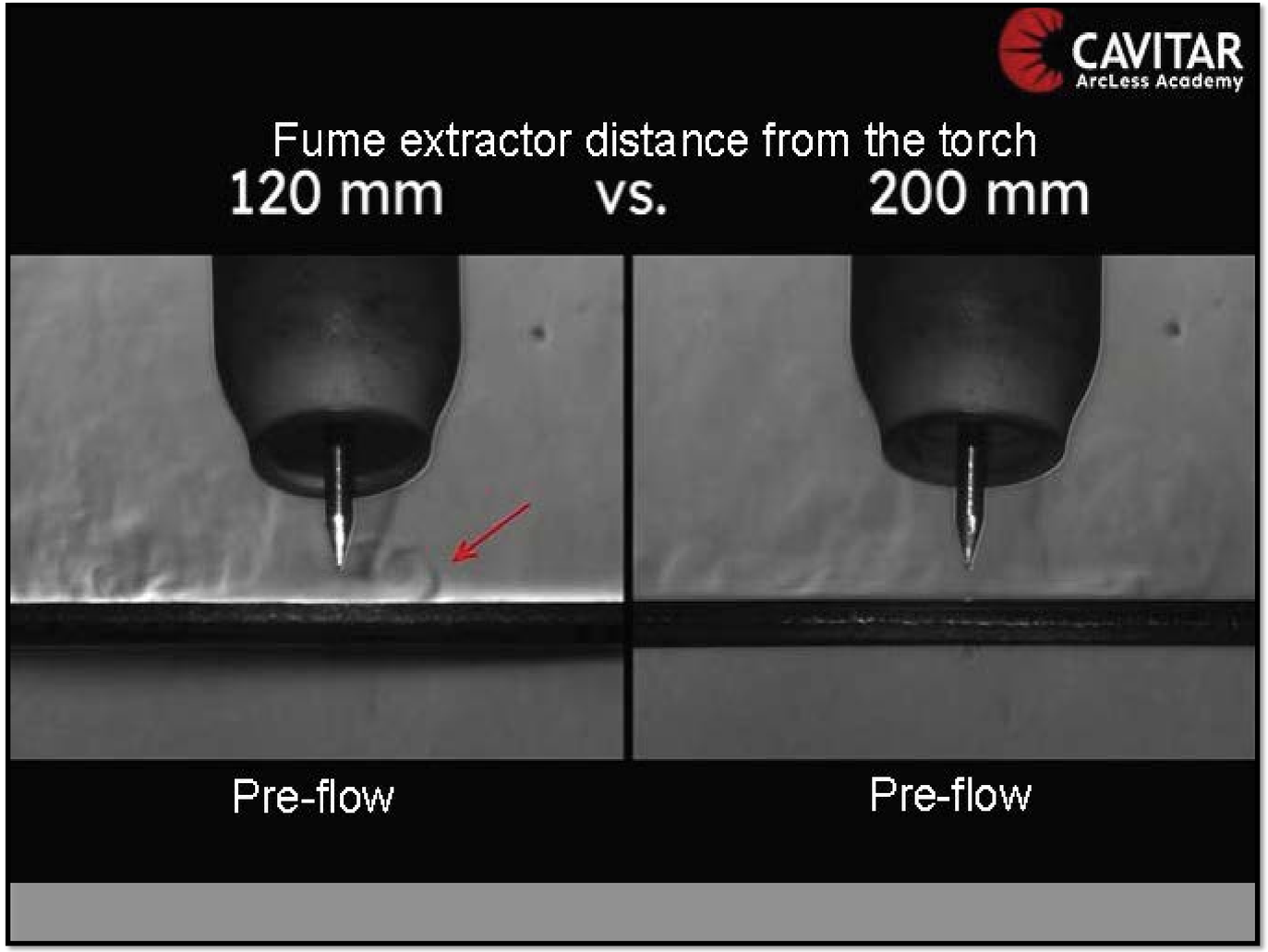
B. WELDING CAMERAS



Video: TIG Welder view, PB position

Video: TIG Side view, PA position

B. HIGH-SPEED AND SCHLIEREN IMAGING

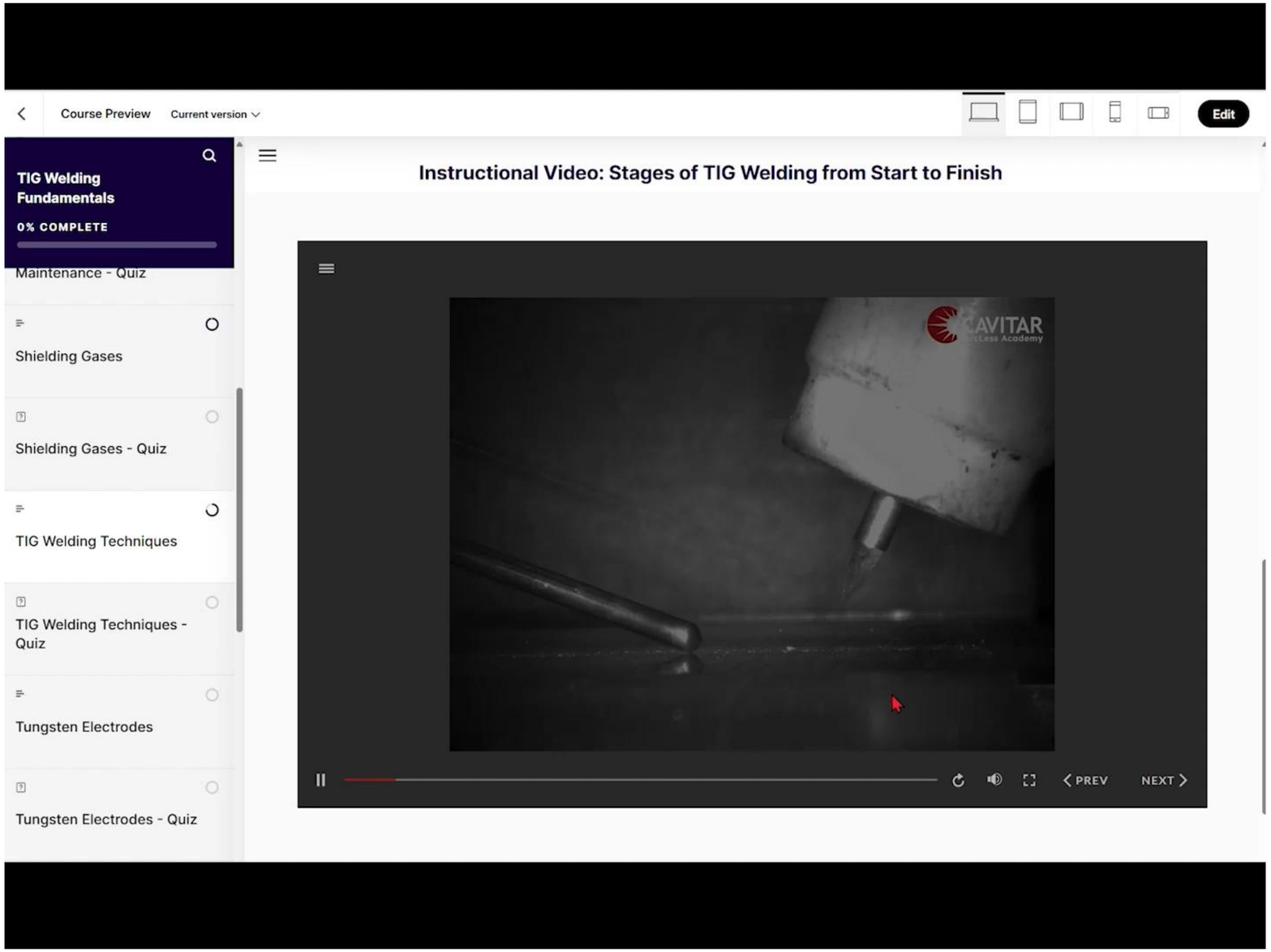


Video: Distance Comparison in Welding – 120 mm vs. 200 mm

C. ONLINE PLATFORM

ONLINE COURSES

- TIG / AWS GTAW →ISO 141
- MIG/MAG / AWS GMAW → ISO 131/135
- MMA / AWS SMAW → ISO 111



D. WELDING CAMERAS AS A TEACHING TOOL

Only few can see **educator´s welding properly**

Individual teaching / learner
4 min x 15 = 60

Welding camera as a tool for teaching

Everyone can see **Saves** educators **time** and **correct techiques** visible **to all.**

Images below: Savo Vocational College Image Bank

D. WELDING CAMERAS AS A TEACHING TOOL

- **Live feed from educator / student welding**
- **Analysis of the weld**

Figure: The weld recorded in the video

Video: Live feed, student welding

Video: Weld analysis

D. WELDING CAMERAS AS A TEACHING TOOL

Operator training and quality control in test runs in a company in Finland

Video: Spatter caused by wire dragging

Video: Invalid welding parameter in the operating software

D. WELDING CAMERAS AS A TEACHING TOOL

Improvements in work safety
Better and safe view to weld

Welding manipulator integrated with welding camera, MV-Welding footage

Video: Work safety improvements and live-quality control

Video: Improved operator view

SPECIAL MATERIALS

Parameter adjustment
“Mastering all the requirements of the process” Speweld Service

Speweld Service footage

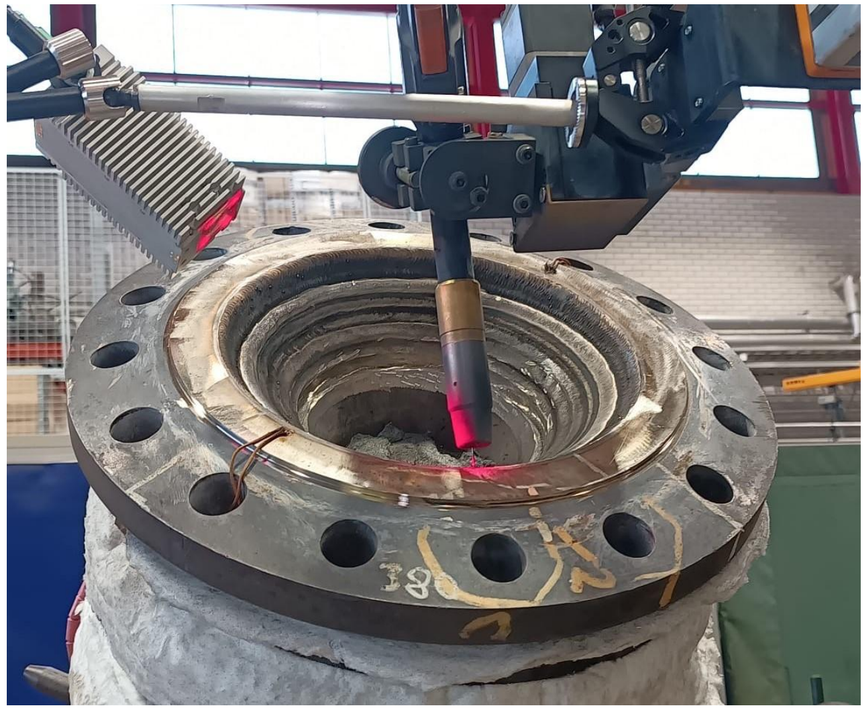


Fig: MAG surface coating, Stellite

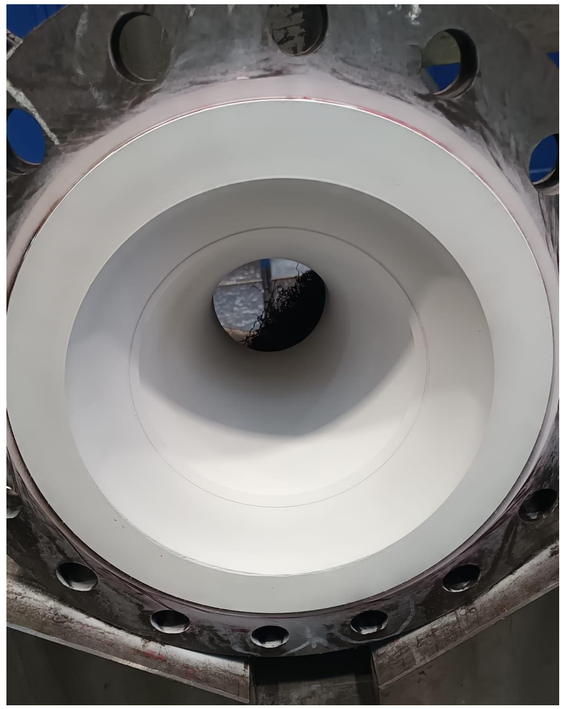
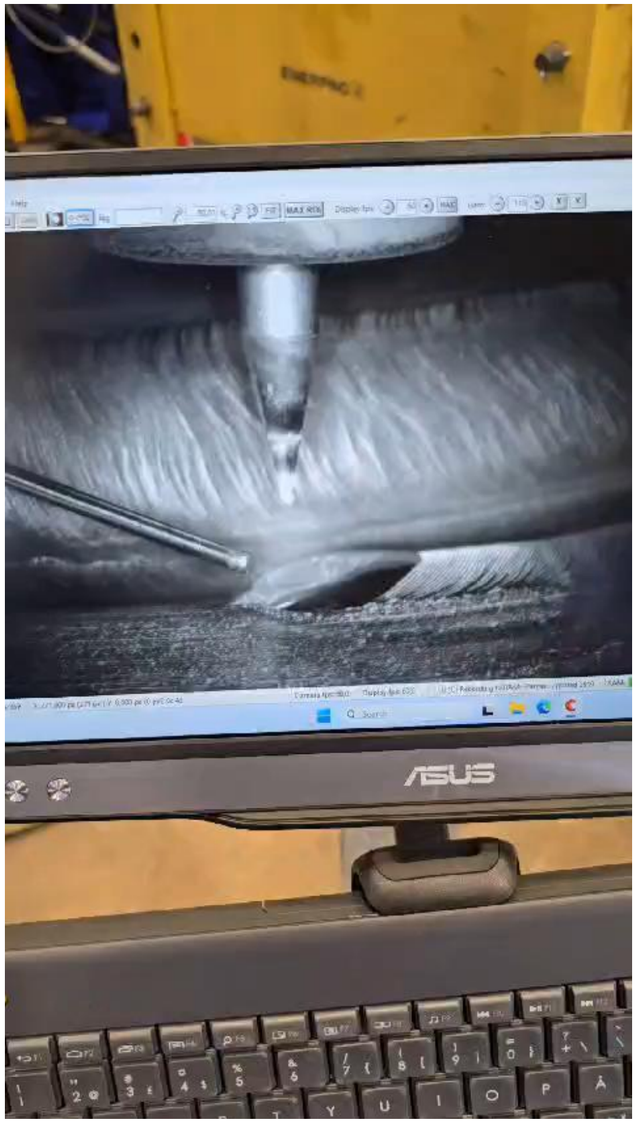


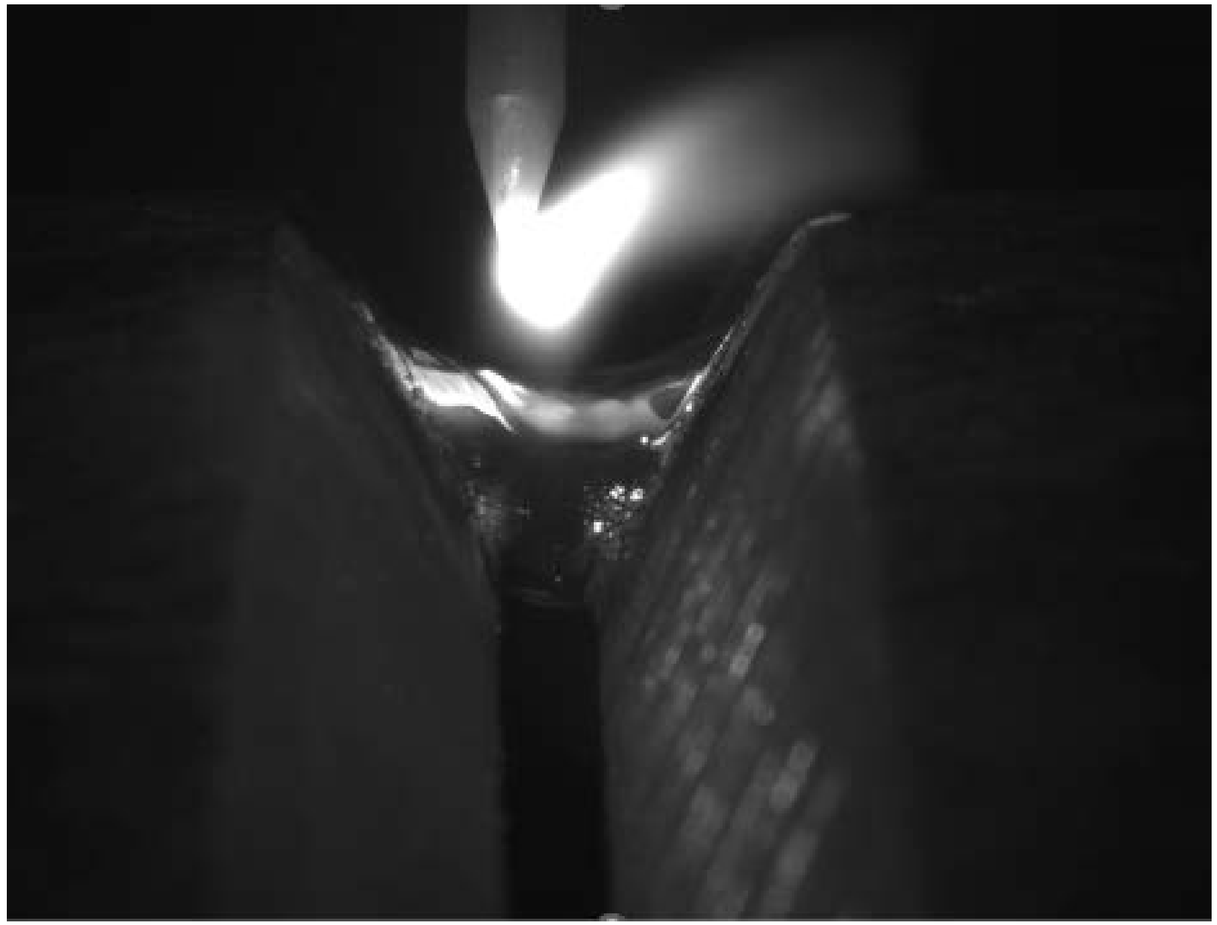
Fig: The Final product



Video: TIG surface coating

SPECIAL MATERIALS AND QUALITY CONTROL

Speweld Service footage



Video: Magnetic Arc Blow in TIG welding

THE SMALLEST DETAILS

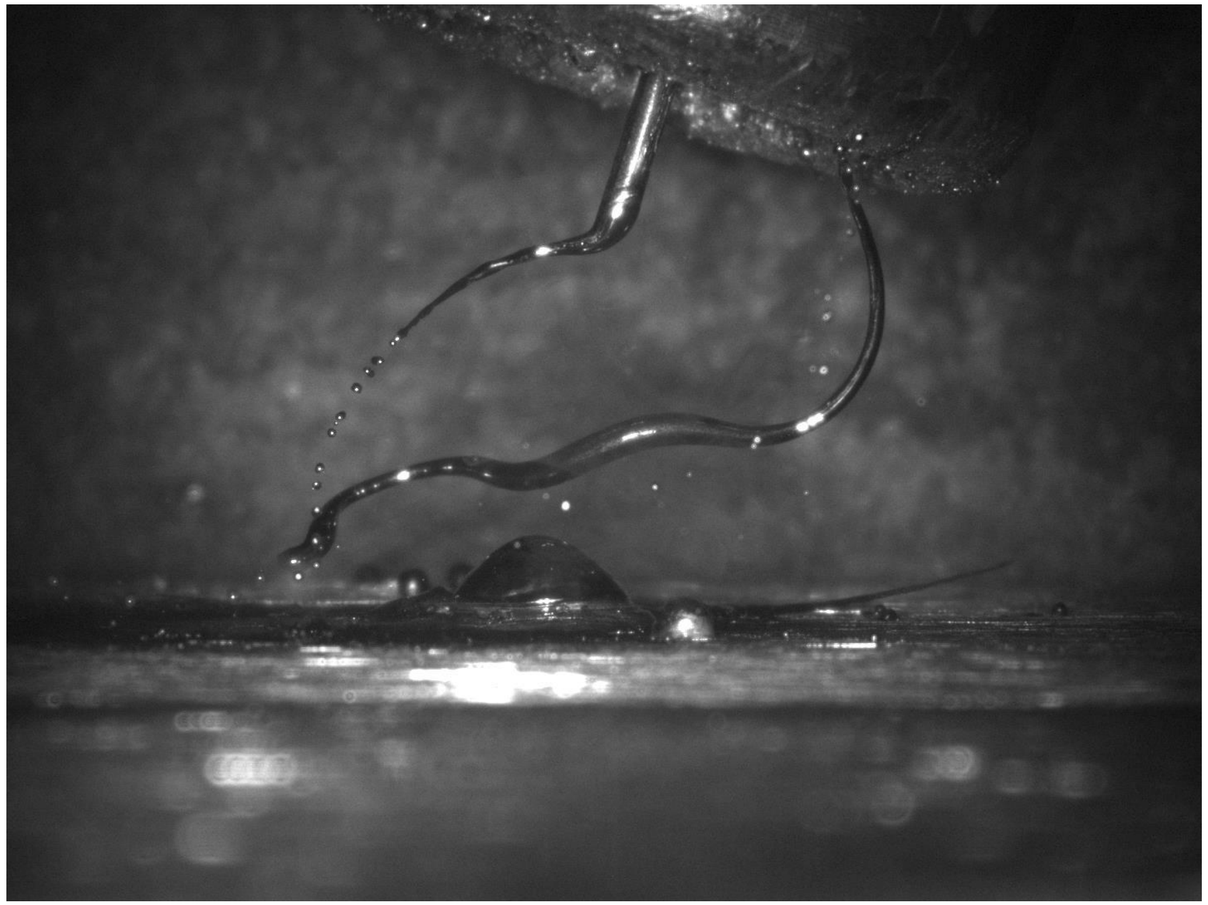


Fig: Poor start in process 135

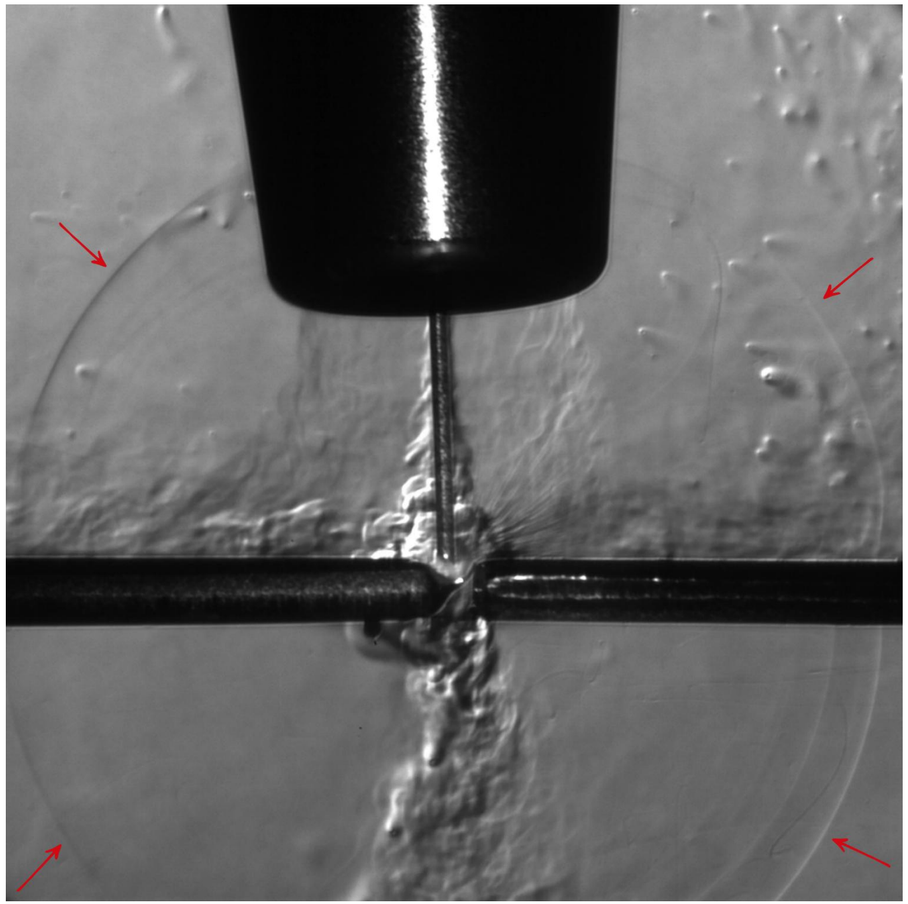
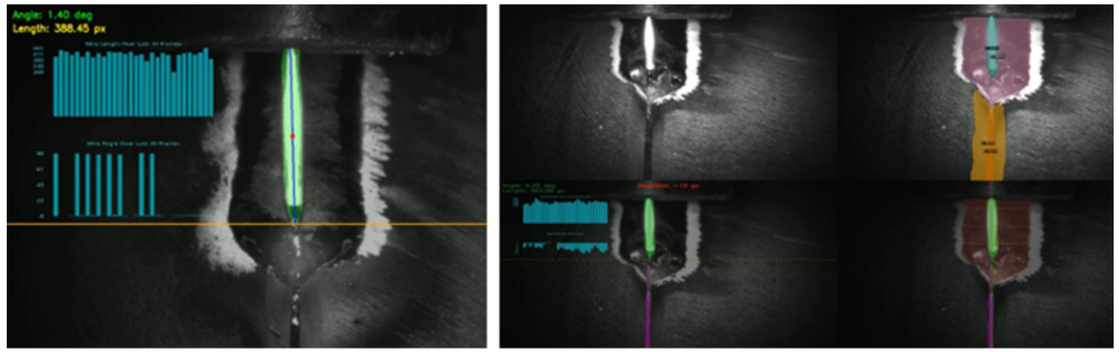


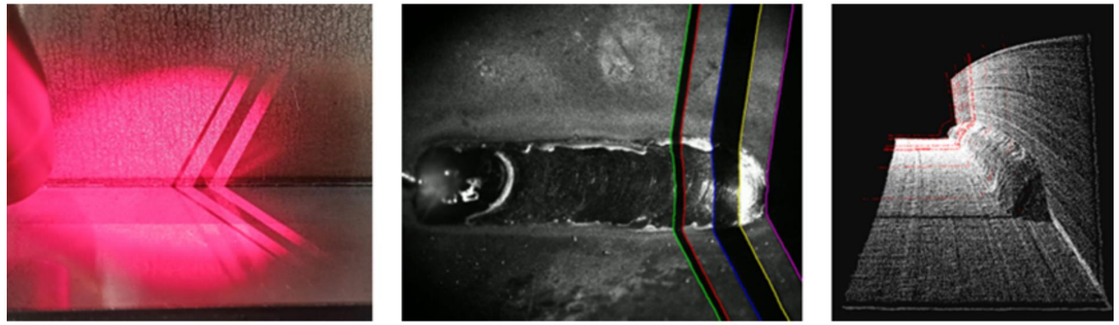
Fig: Schlieren imaging, shockvawe

E FUTURE OPTIONS

Seam Tracking →

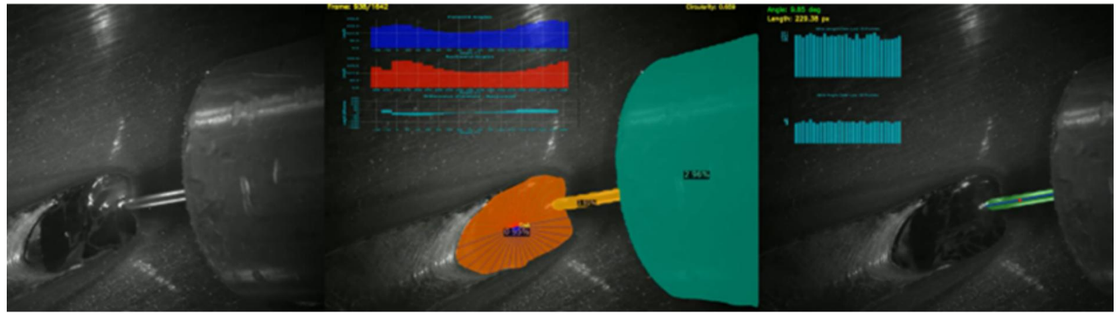


Topography →



→ Throat thickness, Incorrect weld toe

Molten Pool →



→ Overlapping, Sagging, Weld penetration

FEEDBACK FROM WELD EDUCATION

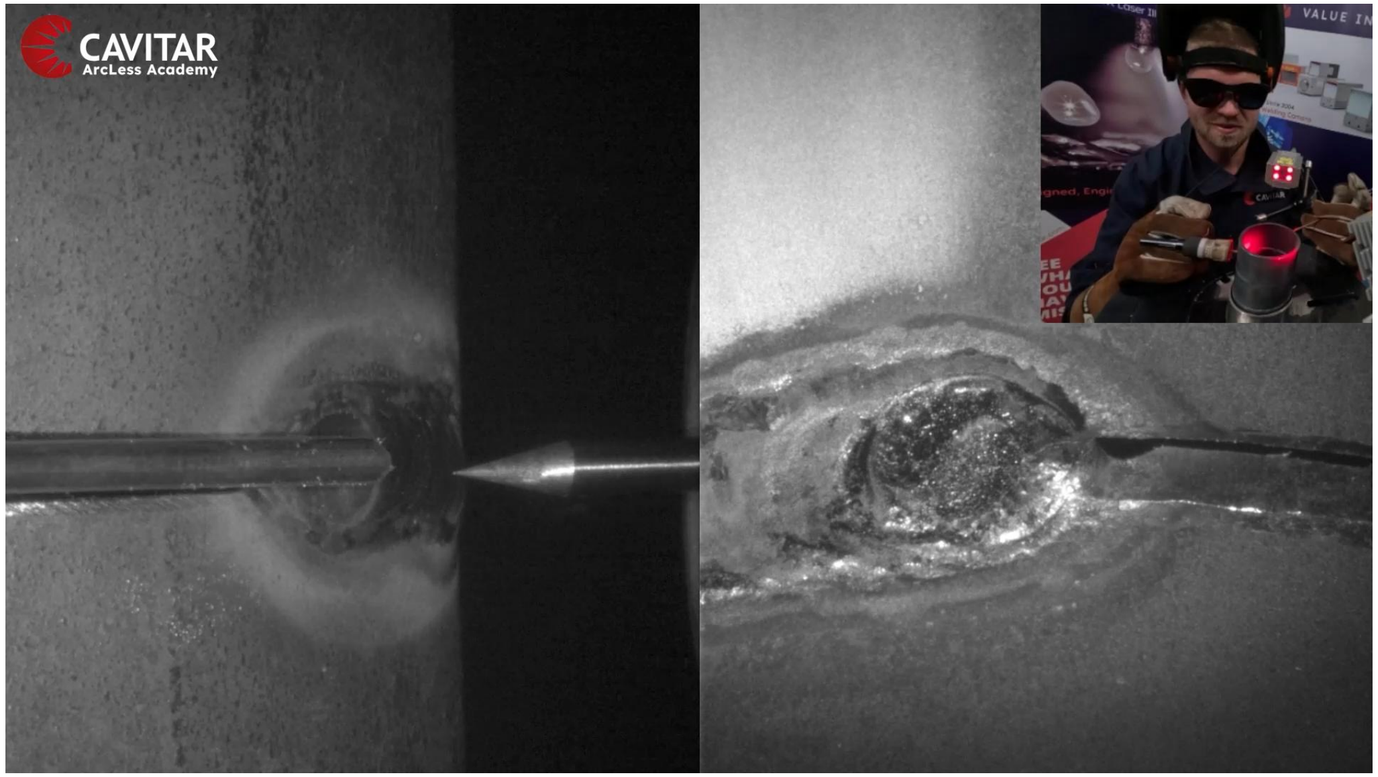
- *Easier to visualize what the weld should look like*
- *With videos we can see surrounding area of the weld pool.*
- *We should have these videos in the beginning of the welding course*
- *Interactive videos are informative*
- *Its good thing that there is pause in the videos*
- *Learner can take time for reading the information*
- *Pointer arrows and figures are good*
- *The weld is much easier to see via welding camera feed and videos*
- *It´s easier to visualize the torch handling and angle" (two students used a welding camera and learned how to correct an incorrect torch angle)*
- *Interactive educational videos*
    - *Interactive videos show welding better than "old" materials (books & brochures) by looking at the picture and reading text*

- *Much quicker to learn welding when using Cavitar ArcLess Academy method"*

FEEDBACK FROM WELDING INDUSTRY

- ✓ *“Finding a parameter error in the welding program.”*
- ✓ *"Real-time monitoring and analysis of the welding defect generation mechanism from the recording.“*
- ✓ *"Adjustment of software parameters is now faster as a result of real-time monitoring, reducing welding errors.“*
- ✓ *"Reduces the number of trials because welding defects are found more quickly and flawlessness makes manufacturing more efficient and you*
- ✓ *"Clear cost savings on labour and inspection, filler metal and welding gases, ensure the implementation of the production plan and secure deliveries”.*
- ✓ *Our Company is based on the LEAN philosophy, and this development helps to operate efficiently and competitively*

E. THE FUTURE OPTIONS



Video: TIG-welding via AR-glasses

[World's First Augmented Reality Welding with **#ArcLessVision** | Cavitar Welding Camera (AR)]
https://www.youtube.com/watch?v=_LmU-EIN5TU

Ett varmt tack till **Svetskommissionen** och alla deltagare och arrangörer av **SLM – Svetslärarmötet** som gjorde detta fina och inspirerande evenemang möjligt!

Stort tack till er alla!

Cavitar Ltd – Tomi Piippo, Juha Kauhanen och Elliot Wilholm